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Last two paragraphs: "Kepler's fame does not rest upon his voluminous works. With his peculiar method of approaching problems there was bound to be an inordinate amount of chaff mixed with the grain, and he used no winnowing machine. His simplicity and transparent honesty induced him to include everything, in fact he seemed to glory in the number of false trails he laboriously followed. He was one who might be expected to find the proverbial 'needle in a haystack,' but unfortunately the needle was not always there. Delambre says, 'Ardent, restless, burning to distinguish himself by his discoveries he attempted everything, and having once obtained a glimpse of one, no labour was too hard for him in following or verifying it. All his attempts had not the same success, and in fact that was impossible. Those which have failed seem to us only fanciful; those which have been more fortunate appear sublime. When in search of that which really existed, he has sometimes found it; when he devoted himself to the pursuit of a chimera, he could not but fail, but even then he unfolded the same qualities, and that obstinate perseverance that must triumph over all difficulties but those that are insurmountable.' Berry, in his *Short History of Astronomy,* says 'as one reads chapter after chapter without a lucid, still less a correct, idea it is impossible to refrain from regrets that the intelligence of Kepler should have been so wasted, and it is difficult not to suspect at times that some of the valuable results which lie embedded in this great mass of tedious speculation were arrived at by a mere accident. On the other hand it must not be forgotten that such accidents have a habit of happening only to great men, and that if Kepler loved to give reins to his imagination he was equally impressed with the necessity of scrupulously comparing speculative results with observed facts, and of surrendering without demur the most beloved of his fancies if it was unable to stand this test. If Kepler had burnt three quarters of what he printed, we should in all probability have formed a higher opinion of his intellectual grasp and sobriety of judgment, but we should have lost to a great extent the impression of extraordinary enthusiasm and industry, and of almost unequalled intellectual honesty which we now get from a study of his works.'

"Professor Forbes is more enthusiastic. In his *History of Astronomy,* he refers to Kepler as 'the man whose place, as is generally agreed, would have been the most difficult to fill among all those who have contributed to the advance of astronomical knowledge,' and again *à propos* of Kepler's great book, 'it must be obvious that he had at that time some inkling of the meaning of his laws—universal gravitation. From that moment the idea of universal gravitation was in the air, and hints and guesses were thrown out by many; and in time the law of gravitation would doubtless have been discovered, though probably not by the work of one man, even if Newton had not lived. But, if Kepler had not lived, who else could have discovered his Laws?'"

Contents—Chapter I: Astronomy before Kepler, 5–12; II: Early life of Kepler, 13–18; III: Tycho Brahe, 19–27; IV: Kepler joins Tycho, 28–34; V: Kepler's laws, 35–51; VI: Closing years, 52–57; Appendix I: List of dates, 59; II: Bibliography, 60; Glossary, 61–62.

Carnegie Institution of Washington. Year Book No. 19, 1920. Published by the Institution, Washington, U. S. A., January, 1921.

In referring to the publications of the year ending October 31, 1920, the president remarks that "three may be cited by reason of their diversity in subject-matter and by reason of special contemporary interests they have aroused." He then proceeds (page 13): "Attention was invited in the report of a year ago to the publication of Volume I of Professor DICKSON's *History of the Theory of Numbers.* Volume II (octavo, pp. xxv + 803) of this work has appeared during this year. It is devoted to what is now called 'Diophantine Analysis,' cultivated alike by the ancient, the medieval, and the modern schools of mathematicians. It is remarkable as the branch of mathematics which has the greatest number of devotees; and its history shows well how the higher developments in science are evolved, in general, out of amateurism and dilettantism. Hence the desirability of commending both these latter stages while at the same time urging individuals to linger in neither. It is especially noteworthy in the volume in question that the French statesman Fermat (1601–1665) should be one of the most prominent of the many famous names which adorn this sort of analysis. It has turned out, in fact, that he is more distinguished for his *Opera Mathematica* than for his high conduct as councillor for the parliament of Toulouse."

BENJAMIN BOSS, director of the department of Meridian Astronomy, makes report on pages 201–207, and Director G. E. HALE gives a summary of the year's work at Mount Wilson Observatory.

GEORGE SARTON makes report (pages 383–385) concerning his work in the History of Science, July, 1919, to August, 1920, under the headings: (*a*) work in Europe; (*b*) history of science; (*c*) Leonardo studies; (*d*) history of physics in the nineteenth century; (*e*) the new humanism.

In the report on Mathematical Physics by F. R. MOULTON, reference is made to the volume on *Periodic Orbits* (*1920*, 472), and to three papers on optical subjects published in *Visual Education*, Chicago. He gives the full program of his colloquium lectures before the American Mathematical Society in 1920, and he notes that "a chapter on numerical integration of differential equations has been written for a volume which is being prepared for the Smithsonian Institution by Professor E. P. ADAMS."

FRANK MORLEY makes report for Mathematics as follows: "Professor COBLE has published his memoir on "The ten nodes of the rational sextic and of the Cayley symmetroid" (*Amer. Jour. Math.*, vol. 41, no. 4, pp. 243–265, October 1919). He has completed a memoir on Double binary forms and the closure property,[1] which develops some new points of view and many new instances.

"Two other researches of Professor Coble which are in progress may be mentioned: In the first, the modular functions of genus 3 are used to obtain a system of irrational invariants of the ternary quartic which can be identified with a similar system arising from the set of seven points in a plane. This connects the rational invariants of the quartic with the invariants of a finite collineation group in 15 variables and would indicate that the complete system of the quartic consists of not more than 17 members.

"The second research connects his discovery that the symmetroid can be transformed by Cremona transformations into only a finite number of distinct types with the fact discovered by Schottky that the symmetroid arises from the modular functions of genus 4. Cremona transformations of the symmetroid are induced by the integer linear transformations of the modular functions, when reduced modulo 2."

Tables of the Digamma and Trigamma Functions. By Eleanor Pairman. (Tracts for Computers, edited by Karl Pearson, no. 1). Cambridge University Press, 1919. 8vo. 19 pages. Price 3 shillings.

The digamma function is $d/dz \log\Gamma(1+z)$ and the trigamma function $d^2/dz^2 \log\Gamma(1+z)$. Their computation facilitates the summation of series of the form

$$S = \sum_{i=1}^{\infty} \frac{a_0 + a_1 i + a_2 i^2 + \cdots + a_{n-2} i^{n-2}}{(p_1 i + q_1)(p_2 i + q_2) \cdots (p_n i + q_n)},$$

where the a's, p's and q's are numerical quantities, and any number of pairs of factors in the denominator may be equal. In work on the torsion flexure of aeroplane propeller blades it was found necessary to sum a large number of series of this form.

"It was not discovered until the present tables were almost completed that a certain portion of the work had been already performed. Gauss (*Werke*, vol. 3, pp. 161, 162 ⋯) gave tables of $d[\log\Gamma(1+z)]/dz$ correct to 18 decimal places for values of z between 0 and 1, the increment in z being .01. Professor G. N. Watson (*Report of the British Association*, 1916, pp. 125, 126) gives tables of the same function correct to 13 decimal places for all integers and halves of odd integers from 0 to 100. These two valuable tables have been made use of as a check on the present 8-figure tables. So far as has been discovered there are no other tables of $d^2 [\log\Gamma(1+z)]/dz^2$."

Prefatory note by K. Pearson: "During the course of the past five years the Department of Applied Statistics in the University of London (University College) has carried out a great deal of computing work of one kind or another bearing on special war problems of a physical character. Its members have been struck by the absence of any simple text-book for the use of computers and still more by the absence of obviously necessary auxiliary tables. The present series of *Tracts for Computers* will endeavour to fill this gap as far as it lies in our power. It will not concern itself with the higher mathematical theory, but solely with the practical difficulties of the computer, or rather such difficulties as we have met with in our own experience. The first tract

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[1] A memoir by Professor Coble, entitled "Multiple binary forms with the closure property," was published in *Amer. Jour. Math.*, vol. 43, January, 1921, pp. 1–19.—EDITOR.